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## (54) Thermochromic liquid crystal devices

(57) A temperature sensitive liquid crystal device comprises a flexible tape including a transparent flexible sheet A onto which is applied a thin layer B of thermochromic liquid crystal, and a backing C with an adhesive layer D applied to the liquid crystal layer. The tape may be used to produce a liquid crystal transfer. In this case the tape is adhered to the surface by layer D and the transparent flexible sheet is then removed. The backing C may comprise PVA impregnated with carbon black.

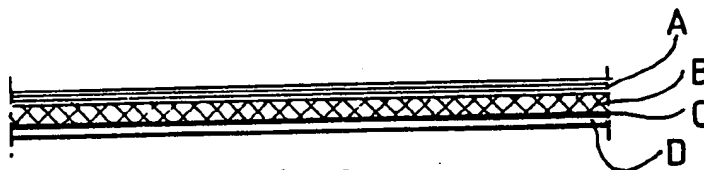
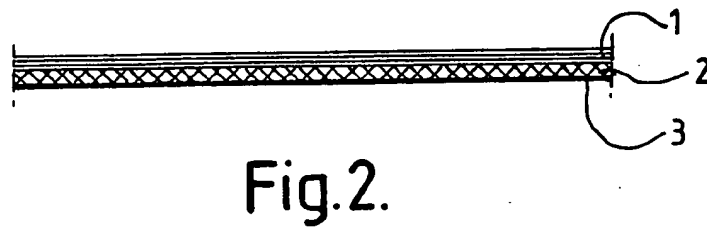
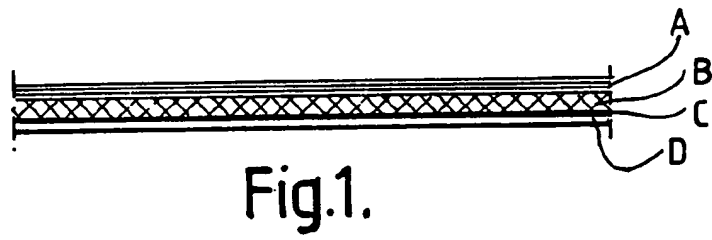


Fig.1.



## SPECIFICATION

## Thermochromic liquid crystal devices

- 5 This invention relates to an improved liquid crystal device for monitoring the temperature of different points on a surface.

Thermochromic liquid crystals are now widely used for measuring and mapping temperatures

- 10 since they change colour at a predetermined temperature.

According to this invention a liquid crystal device for monitoring the temperature across a surface comprises a flexible tape including a transparent flexible sheet onto which is applied a thin layer of thermochromic liquid crystal, and a backing which is applied to the liquid crystal layer, the flexible tape being applied to the surface by adhering the backing to the surface.

- 20 The backing is preferably black and may be polyvinyl acetate (PVA) with carbon black.

The transparent tape is preferably PVC and may be made in rolls of various widths. The thickness may for example be 100-500 gauge.

- 25 Preferably the backing is self-adhesive so that the liquid crystal is brought into direct and intimate contact with the surface with little chance of any trapped air beneath the tape thus ensuring an accurate colour display.

- 30 The liquid crystal formulation may be a dispersion from solution, a dispersion from emulsion or in a micro-encapsulated form. A useful example is a dispersion from emulsion, of 30% liquid crystal in gum arabic with a temperature range of 30.1°C to 40.6°C.

Preferably the range of temperatures of the liquid crystal is between 15 and 40°C.

- 35 If liquid crystals in microencapsulated form are used then liquid crystals with different temperature ranges may be used in combination to provide a more accurate measure of temperature.

An alternative layer of liquid crystal is formed using a solution of liquid crystal in methyl chloroform in conjunction with a polymer solution.

- 45 Very small quantities of liquid crystal are required on such a tape to give good colour display per unit length of tape. This means that the tape provides a relatively cheap way of providing the temperature monitoring of a surface.

- 50 According to further aspect of this invention a method of applying a thin layer of liquid crystal to a surface to be temperature monitored comprising the steps of applying a liquid crystal tape comprising a backing layer and a thin layer of liquid crystal applied to a flexible plastics sheet, on to the surface by adhering the backing to the surface, and subsequently removing the flexible plastics sheet.

Since the liquid crystal is left as a transfer on the surface, it can be used with either a smooth even

- 60 surface, or can be used with an uneven surface.

The plastic sheet may be polythene, PVC, PVA or any other suitable polycarbonate.

The plastics sheet is removable, once the backing has been adhered to the surface so that a liquid

- 65 crystal transfer is left adhered to the surface. This

means that very thin layers of liquid crystal may be applied to surfaces so that the transfer will then adhere to an uneven surface such as skin.

- Also according to this invention there is provided a liquid crystal transfer comprising a backing sheet, and a layer of liquid crystal applied to a flexible plastics sheet, the flexible plastics sheet being removable when the backing sheet has been adhered to a surface, so that the backing sheet and liquid crystal layer are left adhered to the surface.

- 75 The backing sheet may be adhered to the surface by using any suitable adhesive such as gum arabic or the backing sheet may be self-adhesive.

- Such transfers are most useful in the application of thin layers of liquid crystal of skin or any other uneven surfaces.

This means that the liquid crystal transfer may be used to map venous flow of an area infection on any uneven stretch of skin on a human or animal body.

- 85 The liquid crystal transfer is especially useful for investigating points of infection on an animals foot, such as cows or horses hooves.

Where the transfer is to be used to monitor infection the actual level of temperature at a point is not most important. It is more important to measure temperature differences at different points.

- 90 Preferably the liquid crystal used is a mixture of liquid crystals so that temperatures in a range 15°C to 40°C can be measured.

- 95 An example of liquid crystal tape and transfer in accordance with the invention will now be described with reference to the accompanying drawings in which:-

- Figure 1 is a schematic view of liquid crystal tape; and,

Figure 2 is a schematic view of the transfer.

- A thin layer of liquid crystal B is applied to the transparent PVC tape A. The liquid crystal is a dispersion from an emulsion carried in gum arabic with a temperature range of 30.1°C to 40.6°C. A black backing C is applied to the liquid crystal layer. The backing C is PVA with carbon black. A self-adhesive layer D is applied to the back of the backing. The tape is made in rolls of different widths.

- 110 The transfer comprises a 250 gauge polythene sheet 1 to which is applied by screen printing liquid crystal layer 2 and the black backing 3 of black PVA paint is screened on top 2. The surface to be mapped is lightly coated with gum arabic and the transfer is then pressed onto the surface with the backing 3 closest to the surface. The polythene sheet 1 is then peeled away leaving the liquid crystal and the backing on the surface.

## 120 CLAIMS

1. A liquid crystal device for monitoring the temperature across a surface comprising a flexible tape including a transparent flexible sheet onto which is applied a thin layer of thermochromic liquid crystal, and a backing which is applied to the liquid crystal layer, the flexible tape being applied to the surface by adhering the backing to the surface.

2. A liquid crystal device according to claim 1 in which the backing is black.

3. A liquid crystal device according to claim 2 in which the backing is polyvinyl acetate (PVA) with carbon black.
4. A liquid crystal device according to any one of the preceding claims in which the transparent sheet is PVC.
5. A liquid crystal device according to any of the preceding claims in which the thickness of the transparent sheet is in the range 100-150 gauge.
- 10 6. A liquid crystal device according to any one of the preceding claims in which the backing is self-adhesive.
7. A liquid crystal device according to any one of the preceding claims in which the liquid crystal formulation is a dispersion from solution, a dispersion from emulsion or in a microencapsulated form.
- 15 8. A liquid crystal device according to any one of the preceding claims in which the liquid crystal is a dispersion from emulsion of 30% liquid crystal in gum arabic with a temperature range of 30.1°C to 40.6°C.
9. A liquid crystal device according to any one of claims 1 to 7 in which the liquid crystal is formed using a solution of liquid crystal in methyl chloroform in conjunction with a polymer solution.
- 25 10. A method of applying a thin layer of liquid crystal to a surface to be temperature monitored comprising the steps of applying a liquid crystal tape comprising a backing layer and a thin layer of liquid crystal applied to flexible plastic sheet, on to the surface by adhering the backing to the surface, and subsequently removing the plastics sheet.
- 30 11. A liquid crystal transfer comprising a backing sheet, and a layer of liquid crystal applied to a flexible plastics sheet, the flexible plastics sheet being removable when the backing sheet has been adhered to a surface, so that the backing sheet and liquid crystal layer are left adhered to the surface.
- 35 12. A liquid crystal transfer according to claim 11, for detecting infection in an animals foot.
- 40 13. A liquid crystal device according to claim 1, arranged substantially as described herein with reference to Figure 1 of the accompanying drawings.
14. A method of applying a thin layer of liquid crystal to a surface to be temperature monitored according to claim 10, substantially as herein described.
- 45 15. A liquid crystal transfer according to claim 11, arranged substantially as herein described with reference to Figure 2 of the accompanying drawings.
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